MECHANICAL ENGINEER

COMPUTATIONAL FLUID DYNAMICS PREDICTION OF SUBSONIC AXIS-SYMMETRIC AND TWO-DIMENSIONAL HEATED FREE TURBULENT AIR JETS

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A study was conducted to evaluate the accuracy of a commercial computational fluid dynamics (CFD) code (CFDRC-ACE+) for predicting incompressible air jet flows with simple geometries. Specifically, the axis-symmetric and two-dimensional heated air-jets were simulated using a standard k-ε turbulence model. These CFD predictions were directly compared to an extensive compilation of experimental data from archive literature. The round jet results indicated that the code over-predicted the velocity-spreading rate by 24% and the temperature-spreading rate by 29%. In addition, the centerline velocity and temperature decay rates were also over-predicted by 21% and 30%, respectively. The geometric and kinematic virtual origins were over-predicted, as well, by approximately 7.5 diameters for the velocity profiles and 10.5 diameters for the temperature profiles. The planar jet simulation was generally closer to experimental data ranges, with an under-prediction of the velocity-spreading rate of approximately 17% with an over-predicted temperature-spreading rate of 12%. The centerline velocity and temperature decay rates were both under-predicted at 22% and 27%, respectively. Again, the geometric and kinematic virtual origins were over-predicted by approximately 7.5 slot heights for the velocity profiles and 10.5 slot heights for the temperature profiles.

DoD KEY TECHNOLOGY AREA: Modeling and Simulation

KEYWORDS: Computational Fluid Dynamics (CFD), Eductor, Ejector, Gas Turbine, Exhaust, Axisymmetric Jet, Two-Dimensional Jet, Air Jet, Free Turbulent, Jet